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PATENT SPECIFICATION

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(54) METHOD AND APPARATUS FOR CONTINUOUSLY PREPARING A GEL

(71) We, GELCO-PROJECT, LINDREN & CO., HANDELSBOLAG, a Swedish Company, of Skeppargatan 54, S—142 00 Trangsund, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method for the continuous preparation of a gel, especially a water gel intended for extinguishing a fire.

Water gels have proved to be highly effective substances for fighting a fire and are much more effective in this respect than water. The gel will easily adhere to a wall surface or the like in thick layers whereas upon flushing water on to a wall surface only a thin film of water will adhere thereto. This means that the gel has a considerably higher heat capacity than that of water *per se* and a better extinguishing effect on the fire. Furthermore, a gel will be effective in subjugating a fire for a much longer time than would water.

In the past the problem was to find a gel which could be prepared sufficiently rapidly to be practically applicable as a substance for fighting a fire. The present invention overcomes this disadvantage.

Accordingly, we provide a method for continuously preparing and delivering a gel to a usage station by means of a conveying conduit comprising:

i. supplying to said conduit a liquid and a gel-forming substance having the capability of forming a gel when mixed with said liquid, and

ii. controlling the proportions between the supplied volume streams of said liquid and said gel-forming substance to cause the gelatination process to occur substantially during the entire passage through said conduit as a result of admixture of said liquid and said gel-forming substance as they flow through said conduit whereby a finished gel is formed approximate the output end of said conduit and delivered from the output end of said conduit, whereby the pressure drop in the conduit is at substantially the same low level as when only said liquid is passed through said conduit.

According to a further feature of the invention, we provide a method for continuously preparing and delivering a water gel to a usage station by means of a conveying conduit comprising:

i. mixing water and an emulsifying type gel-forming agent to form a gelling mixture,

ii. supplying said gelling mixture and additional water to said conduit, and

iii. controlling the proportion of said additional water and said mixture to cause the gelatination process to occur substantially during the entire passage through said conduit as a result of admixture of said additional water and said gelling mixture as they flow through said conduit whereby a finished gel is formed approximate the output end of said conduit and delivered from the output end of said conduit, whereby the pressure drop in the conduit is at substantially the same low level as when only water is passed through said conduit.

The method of the invention permits the use of a water gel for such fire-fighting purposes where the fire-fighting substance has to be carried through hose conduits, without any higher pressure drops arising in the single conveying conduit or making it necessary to use two separate conduits and for the fireman to carry bulky additional equipment.

The invention will now be described, by way of example, with reference to the figure of the accompanying drawing which shows an apparatus for the preparation of a gel.

Although clearly the invention is applicable for the preparation of different kinds of gel it will be described below for the preparation of a water gel intended for use in fighting a fire.

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A water gel, especially intended for such use where it has to be transported in hose or pipe conduits is prepared by mixing water and a gelling agent during the transport through a conduit. This requires among other things that the gel can be prepared at the same rate at which the water flows through the conduit. All substances which upon mixing with water rapidly produce a gel may be used as gelling agents. One substance particularly adapted for this purpose is the known organic gelling agent which comprises a surface-active polyethylene oxide derivative and a volatilizable hydrocarbon oil which may be a light or a heavy oil. A suitable light oil is for instance white spirit or paraffin-oil. The surface-active polyurethane oxide derivative may comprise alkyl-, aryl or naphthyl polyglycol ethers. The surface-active component in the gelling agent may amount to 10—70%. In the final water gel the concentration of the gelling agent may vary between 0.1% and 10%, preferably between 2% and 4% to cause a gel of desired consistency to be produced.

The gelling agent may be mixed with water in a single step but, preferably, this mixing is carried out in at least two steps in order to minimize the work involved in the mixing step. Indeed, the more water the gelling agent is mixed with the more mixing is required before the gel structure is finished and since the work involved in the mixing is proportional to the length of the conduit, it may in certain applications be necessary to carry out the mixing in several steps. However, the conduit used to deliver the gel at a usage station is used as a mixing chamber, independently of whether one mixing step or more are involved. The gelatination process in this chamber is controlled so that the gel is not finished until at or near the output end of the conduit. Hereby, the problem above discussed and relating to the transport of a gel to a jet nozzle is solved in a simple manner. By making use of the movements of flow in the pipe for the mixing operation and by controlling the gelatination as mentioned above, the gel will be transported through the pipe without any difficulties due to pressure drop in the conveying conduit.

The gelatination process has proved to be very stable and thus it is easy to control it, so that the gel is fully built up first at the output end of the conduit. To obtain a gel structure at the output with about 2% gelling agent the conduit — which may be a standard hose used for fire-fighting — is preferably fed with a gelling agent consisting of a finished or almost finished gel structure having a higher content of the original gelling agent, about 10%, than the final gel. Preferably, this gel used as a gelling agent is obtained in a pre-mixing stage or chamber arranged upstream of the conduit, said chamber being fed with only a part of the total volume of water but with the entire volume of gelling agent. This pre-mixing chamber is designed and fed with water in such a way that a substantially finished gel with a content of gelling agent of about 10% is obtained at its outlet in the conveying conduit where this gel structure is mixed with additional water. Hereby a new gelatination process is started caused by the mixing of the gel with the water through the flow in the conveying conduit and the new gel structure with lower content of gelling agent, preferably 2% to 4%, is progressively built up in the conduit and finished at the output end thereof. This gelatination process may be controlled in several ways, for instance by adjusting the mixing ratio between gelling agent and water. This can be achieved by controlling the amount of additional water fed to the conveying conduit to become mixed with the substantially finished gel from the pre-mixing step. This control may be of any known manual or automatic type. A first coarse adjustment may be made dependent on the number of hoses of standard length used.

An apparatus for preparing a water gel may consist simply of a normal fire-hose having its input end connected to a water supply and being provided with an inlet for receiving the gelling agent which is fed thereto by an adjustable pump. The same input may be used both for water and gelling agent. By adjusting the amounts of water and gelling agent a water gel will progressively be built up along the hose so that a finished gel structure is obtained near the output end of the hose. If necessary, a number of additional hoses may be connected to the first one in which case said amounts have to be adjusted to match the new hose length. When a very short hose or pipe conduit is used or a gel with low content of gelling agent is desired, it may be necessary to connect an additional mixing chamber upstream of the conveying conduit. Said chamber may simply consist of an additional hose or pipe conduit, arranged to be fed with part of the water flow and the entire volume of gelling agent.

Referring now to the figure of the drawing, an apparatus is shown comprising two mixing chambers. A valve 1 controls the flow of water supplied to the apparatus from a pressure water supply such as a fire-pump or the ordinary water mains (not shown). Between said valve 1 and a hose conveying conduit 2 serving to carry the gel to a usage station is connected a pre-mixing stage shown generally at 3. Pre-mixing stage 3 consists of an inner pipe 5 arranged coaxially within an outer pipe 4 connected to the valve 1. The inner pipe 5 is provided

with an inlet pipe 6 for a gelling agent and it is mounted within outer pipe 4 by means of an annular retaining wall 7. The wall 7 serves as a support for the inner pipe 5 and prevents water passing through the space between the outer pipe 4 and the inner pipe 5. The amount of gelling agent fed from a supply, not shown, is controlled by a valve 8 in the pipe 6. A shunt pipe 9 which includes a valve 10 allows water to shunt to the inner pipe 5.

The length of the inner pipe 5 is designed so that a finished or almost finished gel is obtained at its output end 5*a* as a result of the mixing taking place within the pipe. The inner pipe 5 will be of a different length dependent upon the desired content of gelling agent in the gel that is used.

By way of example, the inner pipe 5 has a length of 6 m and a diameter of 38 mm to produce a gel with 10% gelling agent. However, this pipe does not have to be a rigid pipe but may consist of a flexible hose arranged in the outer pipe 4. The outer pipe 4 may also be replaced by a flexible hose. The water flowing through the shunt pipe 9 is mixed with the gel obtained at the outlet 5*a* of the inner pipe 5. This mixture is supplied to the hose conduit 2 which is connected to the pre-mixing stage 3 through standard coupling devices 11. The hose conduit 2 may consist of one or more hoses of standard length having a jet nozzle 12 connected to the output end thereof. During the transport of the mixture through hose conduit 2 a new gel structure will progressively be built up in the hose. By controlling the water flow through shunt pipe 9 this gelatination process can be so controlled that the gel is finished at or within the output end of said conduit, that is to say at the jet nozzle 12. In this way a gel is obtained at the jet nozzle without any difficulties having occurred during the transport in the hose.

The apparatus described above constitutes an attractive device for preparing water gels for fire-fighting purposes. It is of a simple structure, it is reliable, and easy to handle. The apparatus does not complicate the hose laying operation as hoses, coupling means and jet nozzles are of standard types.

The apparatus described above may be varied in different ways; the valves may consist of any known manually or automatically controlled valves. The valves controlling the flow of water through the shunt pipe and the amount of gelling agent may consist of gear pumps if high accuracy is desired. Furthermore, one pre-mixing chamber may be used for feeding a plurality of conveying conduits. Although the invention has been described for the preparation of water gels, it may also be used for preparation of gels of other types. If required, separate means may be arranged at or in the mixing chambers to produce more effective movements of flow therein. The common main principle of all embodiments is that a conveying conduit required for other purposes is used also as an important component in the gelatination process.

Clearly, the method described above may include supplying to the input end of the conduit a gelling agent consisting of a finished or almost finished gel prepared in a preceding step.

WHAT WE CLAIM IS:—

1. A method for continuously preparing and delivering a gel to a usage station by means of a conveying conduit comprising:

i. supplying to said conduit a liquid and a gel-forming substance having the capability of forming a gel when mixed with said liquid, and

ii. controlling the proportions between the supplied volume streams of said liquid and said gel-forming substance to cause the gelatination process to occur substantially during the entire passage through said conduit as a result of admixture of said liquid and said gel-forming substance as they flow through said conduit whereby a finished gel is formed approximate the output end of said conduit and delivered from the output end of said conduit, whereby the pressure drop in the conduit is at substantially the same low level as when only said liquid is passed through said conduit.

2. The method of Claim 1, wherein a portion of the total volume stream of the liquid supplied to said conduit is mixed with a gelling agent in at least one preparatory step to form a gelling mixture having a higher content of gelling agent than is desired in the final gel, and said gelling mixture of relatively high concentration is then supplied to the conduit as said gel-forming substance for the gelatination process occurring in said conduit.

3. The method of Claim 1 wherein said liquid is water; wherein said gel-forming substance is between 2% and 4% of the total amount of said water and said gel-forming substance.

4. A method for continuously preparing and delivering a water gel to a usage station by means of a conveying conduit comprising:

i. mixing water and an emulsifying type gel-forming agent to form a gelling mixture,

ii. supplying said gelling mixture and additional water to said conduit, and

iii. controlling the proportion of said additional water and said mixture to cause the gelatination process to occur substantially during the entire passage through said conduit as a result of admixture of said additional water and said gelling mixture as

they flow through said conduit whereby a finished gel is formed approximate the output end of said conduit and delivered from the output end of said conduit, whereby the pressure drop in the conduit is at substantially the same low level as when only water is passed through said conduit.

5. The method of Claim 4 wherein said gelling mixture contains 10% of said gel-forming agent, and wherein the amount of said additional water is sufficient so that said gel-forming agent is between 2% and 4% of the total of said gelling mixture and of said additional water.

6. The method of Claim 5 wherein said gel-forming agent comprises between 10% and 70% of a surface-active agent and the remainder being a volatilizable hydrocarbon oil.

7. The method according to any preceding Claim wherein the gelatination process is carried out in a number of progressive steps and the conduit is utilized as a mixing chamber for one of said steps.

8. The method according to Claim 7 wherein a gelling agent consisting of a finished or almost finished gel prepared in a preceding step is supplied to the input end of said conduit.

9. A method for continuously preparing a gel substantially as hereinbefore described with particular reference to the figure of the accompanying drawing.

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